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NUTRITION COMMITTEE
FOOD TECHNOLOGY SCHEMES

By

A Special Technical Sub-Committee

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Government of Bengal

Sanitary Board

Nutrition Committee

FOOD TECHNOLOGY SCHEMES.

PREPARED BY

A SPECIAL TECHNICAL SUB-COMMITTEE.

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CALCUTTA
MARCH, 1944

Members of the Nutrition Committee, Sanitary Board, Bengal.

Mookherjee, Dr. B. (Convener).

Bagchi, Rai Bahadur Dr. K. N.
Banerjee, Dr. S.
Banerjee, Mr. G. G.
Basu, Dr. K. P.
Brahmachari, Sir U. N.
Carbery, Mr. M.
Ganguli, Dr. B.
Grant, Dr. J. B.
Gregory, Dr. P. J.
Hedayatullah, Dr. S.
Hora, Dr. S. L.
Kirwan, Lt.-Col. E. O'G.
Mahalanobis, Prof. P. C.
Mahmud Ali, Mr. S.
Malik, Khan Bahadur A. R.
Mitra, Dr. S.
Niogy, Mr. J.
Niogy, Dr. J. P.
Pal, Mr. G. B.
Pal, Dr. R. K.
Ray, Dr. J. C.
Raychaudhuri, Dr. S. P.
Ukil, Dr. A. C.

Guha, Dr. B. C. } Jt. Secretaries.
Sankaran, Dr. G. }

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LIST OF SUB-COMMITTEES.

1. Composition of Foods.

Guha, Dr. B. C. (Convener).
Basu, Dr. K. P.
Ghose, Dr. S. K.
Hedayatullah, Dr. S.
Raychaudhuri, Dr. S. P.
Sankaran, Dr. G.

2. Dietary Studies.

Pal, Dr. R. K. (Convener).
Banerjee, Dr. S.
Guha, Dr. B. C.
Sankaran, Dr. G.

3. Nutrition in relation to Public Health.

Sankaran, Dr. G. (Convener).
Ghose, Dr. (Mrs.) L.
Ghosh, Dr. S. K.
Pal, Dr. R. K.

4. Nutrition in relation to Eye Conditions.

Kirwan, Lt.-Col. E. O'G. (Convener).

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Saha, Dr. D. K.

PREFACE

The Nutrition Committee meeting held on 8th February 1944 discussed methods of ameliorating the after effects of the unprecedented famine of 1943. The value of vitamin rich foods and vitamin concentrates were recognised and it appointed a small technical Sub-committee to submit proposals for production of these. The Schemes presented here are considered sound and practical and should be taken on hand forthwith. The Nutrition Committee would thus demonstrate its sense of responsibility by shouldering the burden of solving a serious social problem not by mere academic discussion but by prompt action.

Sd/- G. G. Banerji,
Secretary,
of the
Technical Sub-Committee.

Calcutta,
20th March, 1944.

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CONTENTS

Pag

INTRODUCTION 1

PHYSIOLOGICALLY ADEQUATE FOOD REQUIREMENTS 1

OPTIMUM DAILY DIET 4

FOOD NEEDS OF BENGAL 5

PRESENT UNSATISFACTORY POSITION 9

SUGGESTIONS FOR SOLUTION 11

ANNEXURES: 14

  1. The extraction of carotene or pro-vitamin A from Water Hyacinth, grass etc. 15
  2. The concentration of Vitamin A & D by molecular distillation. 17
  3. The preparation of yeast rich in B vitamins 18
  4. Dehydration and Refrigeration of foods. 20
  5. The manufacture of synthetic ammonia by the fixation of Nitrogen from the air. 21
  6. Summary statement of costs. 23

INTRODUCTION.

At the dawn of civilisation man learnt to sow cereals. But at that time land was plenty, storage was not a problem, and transportation was hardly necessary. But in the process of urbanisation, the question of the consumer and producer has come to the forefront bringing with it the problem of storage and transport, the keeping qualities of foodstuffs and the economy of space.

PHYSIOLOGICALLY ADEQUATE FOOD REQUIREMENTS.

With the advancement of the science of Nutrition came the knowledge of the human requirements of foodstuffs in terms of chemistry. At the present day, the following may be regarded as the requirements of an optimum daily diet which are based on the conclusions of the Bengal Nutrition Committee. This consists of carbohydrate, protein, fat, minerals and vitamins.

Basic Caloric Requirements

Infants	Calories per day
1 month	500
2 "	600
4 "	700
6 "	850
12 "	1000
Children	
1 to 2 years	1100
2 to 3 "	1200
3 to 5 "	1400
5 to 7 "	1500
7 to 9 "	1700
9 to 11 "	1950
11 to 12 "	2200
12 upwards	2400
16 to 25 "	2500
Pregnant women	2600
Nursing mothers	3000

More calories are required depending upon the amount of physical work being undertaken by the individual.

Protein Requirements

Age	Grams per Kg. of body weight.
0 - 1	5.0
1 - 3	4.5
3 - 5	3.0
5 - 7	2.5
7 -10	2.0
10 -12	1.8
12 -15	2.0
15 -18	2.2
18 -21	1.5
Pregnant women	1.5 (first 3 months)
	2.9 (4 to 9 months).
Nursing mothers	2.5

Fat Requirements

60 to 75 grams of which 50% to be of animal origin.

Mineral Requirements

	Ca(g)	P(g)	Fe(mg)
Children	1.0	1.25	12.5
Adult men	0.75	1.0	10.0
Adult women	0.75	1.0	[illegible]2.5
Pregnant women	1.5	1.75	15.0
Nursing mothers	1.5	1.75	15.0

Vitamin requirements	Normal adults	Children, pregnant women & nursing mothe
Carotene (Pro-vitamin A)	2 mgrs.	3 mgrs.
B-Ioninol (Vitamin A)	1 mg.	1.5 mgrs.
Thiamin (Vitamin B_1)	1.0 mg.	1.5 mgrs.
Riboflavin (Vitamin B_2)	1.0 mg.	2.0 mgrs.
Nicotinic acid (P-P factor)	10.0 mg.	25.0 mgrs.
Ascorbic acid (Vitamin C)	50-60mgrs.	50-60 mgrs.
Calciferol and other D Vitamins	12 ug	25 ug

OPTIMUM DAILY DIET.

An optimum or nearly optimum daily diet, which may be aimed at for an average adult for ordinary active habits may consist generally of the following ingredients.

Unmilled or lightly milled rice	10 oz.
Whole wheat	6 oz.
Pulses	4 oz.
Eggs	One or two
Sugar	2 oz.
Milk & milk products	10 oz.
Fish and meat	4 oz.
Non-leafy vegetables	5 oz.
Green leafy vegetables	5 oz.
Fats and oils	2 oz.
Fruits	3 oz.

Such a diet would supply roughly the following.

Carbohydrate	470 g.
Fat	75 g.
Protein	96 g.
Calcium	1.11 g.
Phosphorus	2 g.
Iron	34 mg.
Carotene	4 mg.
Vitamin A	1166 mg.
Thiamin	2 mg.
Riboflavin	1 mg.
Vitamin C	90 mg.
Calories	2780

FOOD NEEDS OF BENGAL.

Based on the above per capita requirements the total annual food production necessary for the entire population of Bengal will work out as follows:

Annual Production of foods required.	Approximately
Cereal grains (mostly rice & milk)	9.3 million tons
Pulses	2.3 "
Eggs	2.1 billions
Sugar and gur	1.1 million tons
Milk	5.7 "
Fish and meat	2.3 "
Green leafy vegetables	3.0 "
Non-leafy vegetables	3.0 "
Edible oils	1 "
Fruits	1.7 "

It is now possible to produce the various vitamins from non food sources, and the annual amounts of these for the population are :

Annual Production of Vitamins required	Approximately	
Carotene	43	tons
Vitamin A	21	"
Riboflavin	43	"
Thiamin	43	"
Vitamin C	1,071	"
Calciferol	0.21	"

The mineral constituents of our food that need to be produced are:

Annual production of minerals		Approximately	
As compound	(Calcium	0.2	lakh tons
	(Phosphorus	0.3	"
	(Fe	300	tons

For further information refer to the Bulletin of the Bengal Nutrition Committee entitled "Physiologically adequate food requirements" and to the paper on "Planning for Nutrition" by Prof. B.C. Guh Science and Culture, March, 1944.

People have tried to solve their nutritional problem but have met with only partial success, as even in America it was observed that to meet the scientific requirement of nutritive elements from meat, eggs, vegetables, milk etc. would mean a cost of $ 2.50 to $9 per person per week but the income statistics showed that a majority of families having three or four members had not had the means to allocate such an amount on food only. The Massachusettes Institute of Technology has, however, demonstrated the possibility of getting a complete well balanced diet with processed and synthetic foods for only $ 0.42 per week per person. In America processed food averaged 2.3 cents per serving, as compared to over 25 cents if the equivalent nutritive elements are expected from natural foods, and even then it is not so reliable in its nutritional content.

The following quotation is perhaps appropriate to this discussion:

"Synthetic Vitamins and Substances Rich in Vitamins - Progress in the large scale production of these is considerable though it was started less than a decade ago. Synthetic vitamins are now being produced in chemical works on a tonnage basis. In U.S.A. the total annual production of synthetics and concentrates exceeds hundred million dollars. Yet no synthetic vitamin was marketed before 1937. At least a fourth of all retail drug sales in U.S.A. are synthetic vitamins or vitamin concentrates. They are now the largest single class of products handled by the wholesalers. This development or trends in the drug trade will perhaps sustain it in future when environmental hygiene and public health measures succeed in eliminating diseases. Drugs will not be needed by healthy men but vitamins cannot be dispensed with.

This phenomenal development in synthetic vitamins and concentrates industry can now enable production to be stepped up without any limitations imposed by availability of lands. The ideas of person per acre will have to go the way of Malthus. Another feature is that there are not even limitations of income levels to provide optimum requirements of vitamins. With so called 'natural' foods the cost of 'protective' foods is considerably higher than the energy providing foods, the cheap cereals. It is now possible to provide protective factors for a fraction of the cost of producing the required energy foods. These latter are not produced to-day synthetically with the exception perhaps of fats".

PRESENT UNSATISFACTORY POSITION.

It is needless to point out that during the past and prevailing crisis in Bengal the nutritional level of the people is far below par. Even the requirement of carbohydrate, the cheapest of all, is beyond the reach of the most. The gruel distributed during the famine gave barely 800 calories and 25 g. of vegetable protein per head per day.

The problem before the country is to increase the production of rice on the one hand and the preparation of processed foods and synthetic vitamins on the other. Here it may be pointed out that the statistics of the annual output of rice of Bengal shows a variation from 6 to 9 million tons as seen from table given here.

RICE PRODUCTION OF BENGAL

Year	Tons	Year	Tons
1930-31	9,206,000	1937-38	9,034,000
1931-32	9,493,000	1938-39	7,567,000
1932-33	9,364,000	1939-40	8,471,000
1933-34	8,680,000	1940-41	6,043,000
1934-35	8,273,000	1941-42	9,821,000
1935-36	7,208,000	1942-43	6,916,000
1936-37	9,805,000		

It may be of interest in this connection to compare the average production of rice per acre of land in various countries and to note our scandolously low yields.

Yield of rice per acre in different countries

(Report of the Paddy and Rice Enquiry Committee - Vol. I - Govt. of Bengal)

Bulgaria	1,904	Korea	1,759
Egypt	3,179	Siam	1,398
Formosa	2,220	Spain	5,542
Indo-China	1,032	U.S.A.	2,138
Japan	2,988	India	828
Java	1,322	Bengal	884
Italy	4,743		

Bengal's normal requirement of this commodity is about 10 million tons per year if other foodstuffs constituents of an optimum diet are adequately provided for. Owing to influx of persons as a result of the war, the requirement of the province may be estimated at 11 million tons or more.

Regarding the preparation of processed foods in India, nothing is done beyond the dehydration of some vegetables, potatoes, cabbage and carrots and small scale drying of milk most of it also at present for feeding the army.

Regarding the manufacture of synthetic vitamins and vitamin concentrates it should be emphasised that its absence was felt acutely in the treatment of cases of starvation. If these were available in India many deaths could have been avoided.

SUGGESTIONS FOR SOLUTION.

All the above problems can be solved by the scientists of India with the resources available in this country and by the development of the required techniques provided some money is made available for working up the same which is likely to prove to be of great value for fighting the present widespread malnutrition and also to be of permanent benefit for the people of the province.

The use of science and technology in tackling the problem of food and nutrition may be conveyed in the words of Sir Joseph Barcroft, the Chairman of the Food Investigation Board of the Department of Scientific and Industrial Research, England.

"Science has been blamed for rendering possible many of our ills but in the processing of foods it has surely much to show on the side of good. If at the end of the war the housewife cannot reduce the number of times she need go to shop, if she cannot put in her shopping bag several times its present complement of nourishment, if the cabinet minister cannot utilise a given tonnage for the transport of much greater quantities of the essentials of life, if the State cannot promote well being by the prevention of waste and the saving and utilisation of surpluses wherever possible, it will not be the fault of science, rather will it be the fault of the planner".

No doubt money has been spent on what is known as the relief of destitutes but a large part of it m[illegible] [illegible] been as the feeding has not been scientifically planned and the relief has, in many cases, not sustained life but prolonged the misery. It is obvious that unless the diet is not only sufficient in calories but is also reasonably adequate with regard to vitamins, proteins and minerals, the persons concerned become only an easy prey to various diseases and epidemics. It will serve no useful purpose to discuss the past as it cannot be undone, but at least science should guide us now for future planning. At least part of the money available should therefore be directed towards the scientific and technological production of food factors, which would largely correct the prevalent malnutrition and increase the resistance to diseases.

In the annexure schemes for the production of (1) Carotene or pro-vitamin A (2) Vitamin A and D (3) Food yeast rich in B group vitamins (4) various processed food materials and (5) Synthetic ammonium sulphate are given.

ANNEXURES.

In preparing a scheme such as this it was thought desirable to put the entire thing under four different heads such as -

a) The preparation of vitamins and vitamin concentrates.

b) The preparation of concentrated foods.

c) The preservation of easily perishable foods and

d) Manufacture of synthetic fertilisers.

Under the first heading the schemes that can be undertaken are :-

1) The extraction of Carotene from water hyacinth, grass etc.

2) The concentration of vitamin A and D by molecular distillation.

Under the second heading the schemes that can be undertaken are :-

1) The preparation of Yeast and yeast products.

2) The production of liver extracts by compartment dryer.

Under the third heading the schemes that can be undertaken are :-

1) Drying of fluids like milk and eggs with the help of spray dryer.

2) Equipment for decreasing the moisture content of rice, wheat and dal and thereby ensuring their keeping qualities, which otherwise gets spoilt due to the growth of fungus owing to the presence of their natural moisture content. This is a vital problem particularly because large stores of these staple foodstuffs are being built for rationing and subsequent distribution.

3) Refrigeration equipment for the easily perishable common food stuffs, vegetables and fish.

Under the fourth heading the scheme that can be undertaken is:-

Synthetic ammonia by the fixation of nitrogen from air.

THE EXTRACTION OF CAROTENE OR PRO VITAMIN A FROM WATER HYACINTH, GRASS ETC.

Carotene is best administered in solution in any vegetable fat preferably hydrogenated. The nutritive value of a hydrogenated fat would in fact be improved to the level of genuine butter on the addition of about 20 ug. per gm. of the fat. On the above basis such plant will be in a position to convert 7½ tons of cheap vegetable oil like Vanaspati into the level of genuine butter every month. Besides ten times bigger plant can easily be built up and several such may be distributed in places where both water hyacinth as well as electric power are available. Besides obtaining a valuable vitamin a great pest of Bengal can be checked.

The following budget is proposed for undertaking the above work:

Non-recurring:	
One tunnel dryer capable of drying [illegible] Kg of green leafy material complete with motor, fan & other electric equipment	Rs.12,000/-
Grinding mill for powdering the dried leafy material	Rs. 3,000/-
Improved Soxhdet apparatus for the extraction of carotene & other pigments	Rs.10,000/-
Chromatographic absorption equipment for the separation of carotene	Rs. 750/-
Recurring:	
Petroleum Ether	Rs. 3,600/-
Adsorbing chemicals	Rs. 750/-
Power	Rs. 1,500/-
Contingencies	Rs. 2,000/-
Personnel - Person in charge of molecular distillation will attend to this as well	
Total	Rs.33,600/-

THE CONCENTRATION OF VITAMIN A & D BY MOLECULAR DISTILLATION.

Under this scheme it will be possible to produce sufficient vitamin A from shark liver oil to meet the requirement of 2½ million people. The budget for the same is given below:

Non-recurring:

Rotary pump (Geryk type 4S1) 4.8 cft. displacement per mt. vacuum .005 mm. off perfect	Rs. 885/-
½ H.P. motor and switch for above	Rs. 200/-
Rotary pump (Geryk type 8/50), 60 cft. displacement per mt. vacuum .005 mm. off perfect	Rs. 1,330/-
3 H.P. motor and switch for above	Rs. 600/-
Rotary duplex pump (Geryk type 4D5) 24 cft. displacement per mt. and vacuum of .00001 mm. off perfect	Rs. 4,585/-
1½ H.P. motor and switch for above	Rs. 400/-
Oil diffusion pump, 20 litres per sec. displacement and 5 x 10^{-6} mm. vacuum off perfect, with electric heater, switches etc.	Rs. 1,300/-
Oil diffusion pump 150 litres per sec. displacement and less than 10^{-5} mm. together with electric heater & switches	Rs. 2,800/-
Electric vacuum gauge, Thermo-electric Pirani type 1 mm. to 10^{-5} mm.	Rs. 625/-
Electric vacuum gauge ionisation type 1 mm. to 10^{-8}, including spare valves	Rs. 850/-
Other electrical equipment	Rs. 2,000/-
Mechanical equipment	Rs. 6,000/-
Structural alteration, etc. for housing & alterations to wiring etc.	Rs. 3,000/-
Assembly and testing	Rs. 2,000/-
Special pilot dyes	Rs. 500/-
Supplies of shark liver oil etc. for preliminary runs	Rs. 400/-
Contingencies at 20% to cover fluctuation in prices of items 1 to 14 & unforeseen items.	Rs. 6,165/-

Recurring:

Apiezon oils for 7 & 8 above for about 6 charges (about 4 lbs. at Rs.60/- per lb. and about 2 lbs. at Rs.110/- per lb.)	Rs. 460/-
Apiezon grease L about 4 oz.	Rs. 100/-
Special oils for vacuum pumps	Rs. 100/-
Preparation of constant yield mixture	Rs. 500/-
Special glassware and chemicals	Rs.2,000/-

Personnel for one year:

Senior Chemist (Rs.650-35-1000)	Rs. 7,800/-
Biochemist (Rs.300-25-600) @ Rs.300 p.m.	Rs. 3,600/-
Technician (Rs.75-5-100) @ Rs.75 p.m.	Rs. 900/-
2 Laboratory Assistants (Rs.40-5-60) @ Rs.40 p.m. each	Rs. 960/-
Total -	Rs.50,060/-

THE PREPARATION OF YEAST RICH IN B VITAMINS

Yeast though a comparatively new food product has an immense possibility as this supplies all the B group of Vitamins and protein of high biological value. The plant proposed can produce enough dry yeast to feed 9,000 persons per day.

Equipments (Capital expenditure):

Water Reservoir and Pump	Rs. 3,000/-
Clarification Vat	Rs. 1,000/-
Aeration Tank	Rs. 1,000/-
Blower	Rs. 1,000/-
Filter Press	Rs. 1,000/-
Cooling arrangement	Rs. 7,000/-
Dryer	Rs. 5,000/-
Separator	Rs. 3,000/-
Contingencies	Rs. 5,000/-

Running Expenditure:

Raw materials	Rs.23,000/- *
Stuff	Rs.15,000/-
Power	Rs. 2,000/-
Contingencies	Rs. 4,000/-
Total -	Rs.71,000/-

* Including [illegible] ammonia, acid.

DEHYDRATION AND REFRIGERATION OF FOODS.

Non-recurring:	
Grain dehydrator (to dry nearly 6 tons of grains per month. This will be a pilot plant to demonstrate the process and larger plant can be built on this model)	Rs. 4,000/-
Spray dryer (to process 10 gallons of milk per day)	Rs. 1,000/-
Compartment Dryer	Rs. 6,000/-
Refrigerating Plant	Rs.12,000/-
Recurring:	
Electricity and other contingencies	Rs. 4,000/-
Personnel:	
One Biochemist (Rs.300-25-600)	Rs. 3,600/-
Four Technicians (Rs.75-5-100)	Rs. 3,600/-
One Engineer Mechanical-cum-electrical (Rs.300-25-600)	Rs. 3,600/-
One Draughtsman (Rs.150-15-300)	Rs. 1,800/-
Two attendants (Rs.28-2-35)	Rs. 672/-
Total -	Rs.40,272/-

MANUFACTURE OF SYNTHETIC AMMONIA BY THE FIXATION OF NITROGEN FROM THE AIR

According to most authorities ammonium sulphate judicially applied to the soils can increase the yield of crops from 50 to 100% or more. Bengal alone may requires 270 lakh maunds of ammonium sulphate per annum. This is of course to supplement other manures now being employed (i.e.) compost, bone and fish meal, phosphate manures etc.

The following scheme will enable manufacture of a pilot plant of suitable type which can be later built up into a small sized factory plant capable of producing $\frac{1}{4}$ ton of synthetic NH_3 per day or 2 tons of Ammonium sulphate per day or about 600 tons per annum or 0.16 lakh maunds of ammonium sulphate per annum.

Plants can also be put up capable of producing 100,000 tons per annum. In all these cases a pilot plant of the nature that is proposed to be built up is a prime necessity for purposes of control and improvements.

Capital Expenditure:

Hydrogen Generators:	
(A) Electrolytic	Rs. 10,000/-
(B) From water gas	Rs. 12,000/-
Nitrogen Generators from Air	Rs. 50,000/-
Convertor & Assembly (American type)	30,000/-
Circulating pump & Compressors	Rs. 30,000/-
Gas holders, gauzes, pipe line etc.	Rs. 25,000/-
	Rs.157,000/-

Recurring Expenditure:

Raw materials, Gas & Power	Rs. 10,000/-
Contingencies	Rs. 3,000/-
	Rs. 13,000/-

Personnel;

One Technologist (650-35-1000)	7,800/-
Three Chemists (300-25-600)	Rs. 10,800/-
One Mechanical-cum-electric Engineer (300-25-600)	Rs. 3,600/-
One Draughtsman (150-15-300)	Rs. 1,800/-
Six Technicians (75-5-100)	Rs. 5,400/-
Two bearers (28-2-35)	Rs. 600/-
	Rs. 30,000/-
Total -	Rs.200,000/-

SUMMARY STATEMENT OF COSTS.

1. The extraction of carotene or pro-vitamin A from Water Hyacinth, grass etc.	Rs. 33,600/-
2. The concentration of Vitamins A & D by molecular distillation	Rs. 50,060/-
3. The preparation of Yeast rich in B vitamins	Rs. 71,000/-
4. Dehydration and Refrigeration of foods	Rs. 40,272/-
5. Manufacture of synthetic ammonia by the fixation of nitrogen from the air .	Rs. 200,000/-
TOTAL -	Rs. 394,932/-
Add for other unforeseen expenses and for a round figure	Rs. 5,068/-
GRAND TOTAL -	Rs.4,00,000/-

(*Continued from inside of front cover.*)

5. **Nutrition in relation to Agriculture.**

Carbery, Mr. M. (Convener).
Basu, Dr. K. P.
Chatterji, Mr. I. B.
Gregory, Dr. F. J.
Hedayatullah, Dr. S.
Paul, Mr. G. B.
Sen, Dr. A. T.
Raychaudhuri, Dr. S. P.
(Local Secretary, Dacca.)

6. **Nutrition in relation to Marketing.**

Malik, Khan Bahadur A. R. (Convener).
Guha, Dr. B. C.
Mahmud Ali, Mr. S.
Niogy, Mr. J.
Niogy, Dr. J. P.
Sankaran, Dr. G.

7. **Technology of Foods.**

Guha, Dr. B. C. (Convener).

Basu, Dr. K. B. P.
Sankaran, Dr. G.

8. **Food Standards.**

Bagchi, Rai Bahadur Dr. K. N. (Convener).
Bose, Dr. P. K.
Brahmachari, Sir U. N.
Ghosh, Dr. S.
Ghosh, Dr. S. K.
Guha, Dr. B. C.
Mazumdar, Mr. M. N.
Niogy, Mr. S.
Sankaran, Dr. G.
Sen, Dr. A. K.
Sengupta, Mr. P. N.

9. **Basic Researches.**

Guha, Dr. B. C. (Convener).
Basu, Dr. K. P.
Ray, Dr. J. C.
Sankaran, Dr. G.

10. **Statistical.**

Mahalanobis, Prof. P. C. (Convener).

Bose, Mrs. C.
Chandra Sekar, Dr. C.

11. **Education and Publicity.**

Grant, Dr. J. B. (Convener).
Biggar, Dr. J.
Brahmachari, Sir U. N.
Ganguli, Dr. B.
Guha, Dr. B. C.
Niogy, Mr. J.
Sankaran, Dr. G.
Ukil, Dr. A. C.

12. **Publications.**

Sankaran, Dr. G. (Convener).
Carbery, Mr. M.
Guha, Dr. B. C.
Grant, Dr. J. B.
Malik, Mr. A. R.

SPECIAL TECHNICAL SUB-COMMITTEE
OF THE NUTRITION COMMITTEE, SANITARY BOARD, GOVT. OF BENGAL.

MEMBERS

B. C. GUHA,

Professor of Applied Chemistry,
University College of Science and Technology.

G. SANKARAN,

Professor of Biochemistry and Nutrition,
All India Institute of Hygiene and Public Health.

SECRETARY

G. G. BANERJI,

Director,
Calcutta Clinical Research Association, Ltd.

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